REMARKS

This Amendment and Response is submitted in reply to the Office Action mailed June 3, 2004. Claims 1-49 and 59 have been canceled and new claims 61-111 are pending. Reexamination and reconsideration is respectfully requested.

Claims 11 and 21-29 were rejected under 35 U.S.C §112(2) as being indefinite. New independent claim 61 recites "the reinforcing structure is attached to a plurality of longitudinal rovings and pulled through a pultrusion die along a continuous longitudinal pull direction".

Claims 61 and 110 recite a method of making a reinforcing structure that is 1) very thin, 2) possesses high lateral strength and 3) is able to withstand the forces encountered during the pultrusion process. The claimed mat significantly reduces the thickness of the reinforcing structure by arranging each layer of reinforcing fibers in a generally planar, non-overlapping configuration.

New independent claim 61 recites 1) arranging a plurality of first reinforcing fibers in a direction generally transverse to the longitudinal pull direction in a generally planar, non-overlapping configuration so that the first reinforcing fibers do not extend over or cover one another and 2) arranging a plurality of second reinforcing fibers in a direction different than the direction of the first reinforcing fibers and in a generally planar, non-overlapping configuration so that the second reinforcing fibers do not extend over or cover one another. Additional layers having the same non-overlapping configuration can also be added.

New independent claim 110 recites 1) arranging a plurality of first reinforcing fibers in a direction generally transverse to the longitudinal pull direction in a generally planar, non-overlapping configuration so that the first reinforcing fibers do not extend over or cover one another and 2) arranging a plurality of second reinforcing fibers in the longitudinal pull direction and in a generally planar, non-overlapping configuration so that the second reinforcing fibers do not extend over or cover one another. Support for these limitations is found in the specification on page 18, lines 15-24.

Claims 61 and 110 also recite a reinforcing structure that provides longitudinal strength, shear strength and anti-skew properties sufficient to substantially maintain the relative orientations of the first and second reinforcing fibers when subjected to the pulling forces encountered during pultrusion.

The resulting reinforcing structure is very thin. The method of preparing the reinforcing structure results in a claimed thickness of 0.020 inches or less. A reinforcing structure with two layers of reinforcing fibers according to the present invention can theoretically have a thickness of about the diameter of two reinforcing fibers, although in practice the mat is thicker due to the permeable transport web and manufacturing variability. The following quote from the specification summarizes the benefits of the present reinforcing mat:

> "The present reinforcing mats 18 or 18A permit the manufacture of pultruded parts with wall thicknesses of about 0.10 inches, and preferably about 0.06 inches and more preferably about 0.03 inches or less.
>
> The resin matrix 20 comprises about 20-40% of the cost of the pultruded part 10. Minimizing wall thickness minimizes resin cost. The thin reinforcing mat 18 with high transverse strength of the present invention permits a reduction in wall thickness without compromising transverse strength. (Specification, page 13, lines 12-19).

The present reinforcing mat typically has a compressed thickness of about 0.004 inches to about 0.020 inches. In another embodiment, the reinforcing mat has a compressed thickness of about 0.010 inches to about 0.012 inches. Since the reinforcing mat can be made relatively thin with a low areal density and reinforcing fibers oriented in the transverse direction, the present reinforcing mat can be used to make very thin pultruded parts. (Specification, page 13, lines 12-25).

> "The present reinforcing mat permits about a 33% reduction in wall thickness with the same or greater transverse strength than pultruded parts reinforced with conventional continuous filament mats. Wall thickness of about 0.039 inches using the present reinforcing mats have demonstrated a transverse tensile strengths of about 20,000 psi." (Specification, page 14, lines 4-8).

Applicants respectfully submit that the benefits discussed above are not provided by any of the cited references, either alone or in combination.

Claims 1-15, 18-31, 34-36, and 59 were rejected under 35 U.S.C. §102(b) as being anticipated by, or in the alternative, obvious under 35 U.S.C. §103(a) over U.S. Patent No. 4,752,513 (Rau et al.). Figure 5 of Rau (4,752,513) illustrates a plurality of overlapping continuous strand layers (reinforcing fibers 4-7) that crisscross the mat 62. The overlapping reinforcing fibers 4-7 of Rau stack up and increase the thickness of the reinforcing mats so that each layer of Rau has a thickness of more than one reinforcing fiber diameter. The overlapping reinforcing fibers 4-7 of Rau increase the thickness of the resulting reinforcing mats 77 and 78 and the wall thickness of pultruded parts made using the mat of Rau, increasing resin usage, weight and cost of the pultruded part. Rau does not teach or disclose two (or more) layers of reinforcing fibers arranged with each layer having a generally planar, non-overlapping configuration so that the reinforcing fibers in a given layer do not extend over or cover one another.

Applicants submit that Rau is also silent as to a method of preparing a reinforcing structure that provides longitudinal strength, shear strength and anti-skew properties sufficient to substantially maintain the relative orientations of the first and second reinforcing fibers when subjected to the pulling forces encountered during pultrusion.

The only discussion of mat thickness in Rau is a reference to the barb needles of the needling machine passing "through the polyester mat to a depth of about 0.8 inches on the downward stroke." (Rau, column 8, lines 26-30). Consequently, Rau does not teach or disclose the claimed thickness of 0.020 inches or less.

Claims 16-17 and 38 were rejected under 35 U.S.C. §103(a) as being unpatentable over Rau and further in view of U.S. Patent No. 3,761,345 (Smith). It is suggested on page 7 of the Office Action that it would have been obvious to replace the reinforcing structure taught by Rau with the reinforcing structure taught by Smith.

As illustrated in Figure 4 of Smith (3,761,345), the first layer 20 overlaps itself at least once so that it has a thickness of at least two reinforcing fiber diameters. Similarly, as illustrated in Figure 5 of Smith, the third layer 60 overlaps itself at least once. When combined with the first layer 50, the reinforcing material of Smith is at least five reinforcing

fiber diameters thick, even before the addition of the stitching or any other layers disclosed in Smith.

Smith does not teach or disclose two (or more) layers of reinforcing fibers arranged with each layer having a generally planar, non-overlapping configuration so that the reinforcing fibers in a given layer do not extend over or cover one another. Smith is also silent as to a method of preparing a reinforcing structure that provides longitudinal strength, shear strength and anti-skew properties sufficient to substantially maintain the relative orientations of the first and second reinforcing fibers when subjected to the pulling forces encountered during pultrusion. Finally, Smith is silent as to mat thickness. Consequently, Smith does not teach or disclose the claimed thickness of 0.020 inches or less. Consequently, Applications submit that claims 61-111 distinguish over the cited references and are in condition for allowance.

Claim 32-33 and 37 were rejected under 35 U.S.C. §103 as being unpatentable over Rau, and further in view of U.S. Patent No. 5,908,689 (Dana et al.). Dana (5,908,689) discloses a reinforced polymeric composite having a primary layer formed from a plurality of randomly oriented essentially continuous glass fiber strands. (Dana, column 3, lines 24-26). The secondary layer comprises a plurality of fiber strands of discontinuous lengths. (Dana, column 11, lines 43-44). As best illustrated in Figures 2 and 2a of Dana, the loops of continuous glass fiber strands overlap so that the resulting reinforcing structure may be as much as twelve reinforcing fiber diameters thick in some locations.

Dana does not teach or disclose two (or more) layers of reinforcing fibers arranged with each layer having a generally planar, non-overlapping configuration so that the reinforcing fibers in a given layer do not extend over or cover one another. Dana is also silent as to a method of preparing a reinforcing structure that provides longitudinal strength, shear strength and anti-skew properties sufficient to substantially maintain the relative orientations of the first and second reinforcing fibers when subjected to the pulling forces encountered during pultrusion and to the claimed thickness of 0.020 inches or less. Consequently, Applications submit that claims 61-111 distinguish over the cited references and are in condition for allowance.

Claims 1-7, 18-31, 34-36, 38 and 59 were rejected under 35 U.S.C. §102(b) as being anticipated by, or in the alternative, obvious under 35 U.S.C. §103(a) over Smith. Smith discloses a non-woven structure that is held together by needling and stitching. (Smith, column 6, lines 12-27 and column 8, lines 42-47). As discussed above, Smith does not teach or disclose 1) two (or more) layers of reinforcing fibers arranged with each layer having a generally planar, non-overlapping configuration so that the reinforcing fibers in a given layer do not extend over or cover one another, 2) a method of preparing a reinforcing structure that provides longitudinal strength, shear strength and anti-skew properties sufficient to substantially maintain the relative orientations of the first and second reinforcing fibers when subjected to the pulling forces encountered during pultrusion, or 3) the claimed thickness of 0.020 inches or less. Consequently, Applications submit that claims 61-111 distinguish over the cited references and are in condition for allowance.

Claims 1-49 and 59 were rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 5,910,458 (Beer et al.) in view of 5,055,247 (Vane). Beer (5,910,458) discloses the thickness of the secondary layer in the range of about 0.25 inches to about 12 inches prior to needling (Beer, column 17, lines 35-37). After needling the mat has a compressed average thickness of about 0.2 inches to about 0.8 inches (Beer, column 18, lines 58-62). The minimum mat thickness of 0.2 inches disclosed in Beer is with a single layer of reinforcing fibers. When combined with multiple layers of reinforcing structure, such as disclosed in Vane, the proposed combination has a thickness that is at least an order of magnitude greater than the claimed thickness of about 0.020 inches or less. If the stitching layer of Vane is included, the mat thickness will increase further. Beer and Vane are also silent as to a method of preparing a reinforcing structure that provides longitudinal strength, shear strength and anti-skew properties sufficient to substantially maintain the relative orientations of the first and second reinforcing fibers when subjected to the pulling forces encountered during pultrusion. Consequently, Applications submit that claims 61-111 distinguish over the cited references and are in condition for allowance.

Should any fee be required, the Commissioner is authorized to charge the Faegre & Benson deposit account no. 06-0029 and in such event, is requested to notify us of the same.

Respectfully Submitted,

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